

Fig. 1

- 20 * FOOD AND KINDRED PRODUCTS
 - 21 TOBACCO PRODUCTS
 - 22 TEXTILE MILL PRODUCTS
 - 23 APPAREL AND OTHER TEXTILE PRODUCTS
 - 24 LUMBER AND WOOD PRODUCTS
 - 25 FURNITURE AND FIXTURES
 - 26 PAPER AND ALLIED PRODUCTS
 - 27 PRINTING AND PUBLISHING
 - 28 CHEMICALS AND ALLIED PRODUCTS
 - 29 PETROLEUM AND COAL PRODUCTS
 - 30 RUBBER AND MISC. PLASTICS PRODUCTS
 - 31 LEATHER AND LEATHER PRODUCTS
 - 32 STONE, CLAY, AND GLASS PRODUCTS
 - 33 PRIMARY METAL INDUSTRIES
 - 34 FABRICATED METAL PRODUCTS
 - 35 INDUSTRIAL MACHINERY AND EQUIPMENT
 - 36 ELECTRONIC & OTHER ELECTRIC EQUIPMENT
 - 37 TRANSPORTATION EQUIPMENT
 - 38 INSTRUMENTS AND RELATED PRODUCTS
 - 39 MISCELLANEOUS MANUFACTURING INDUSTRIES
- (* THE NUMBERS AHEAD OF THE INDUSTRIES INDICATE THE SIC CODE)

Fig. 2a

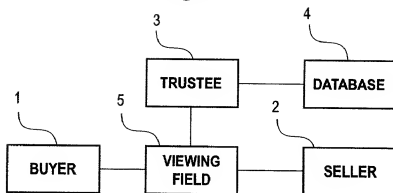


Fig. 2b

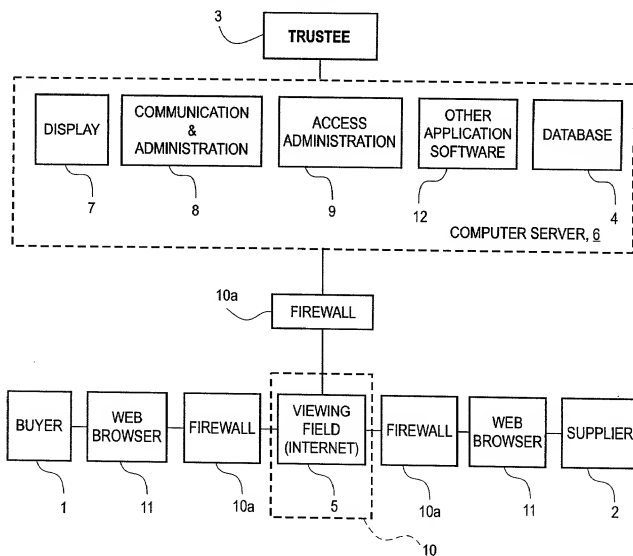
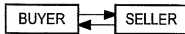
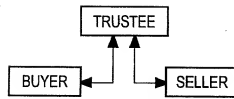


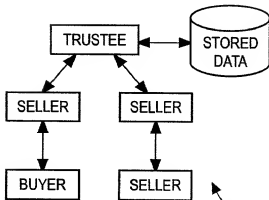
Fig. 2c



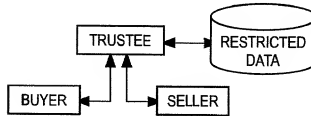
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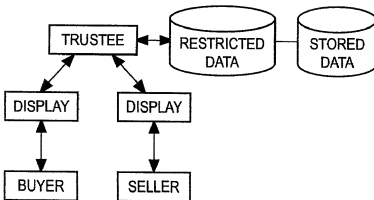
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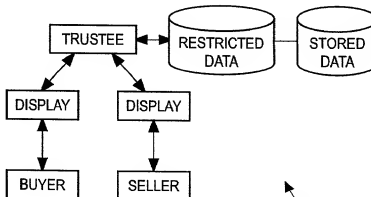
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16



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18

Fig. 3

BUYER ACTIONS

4/17

SUPPLIER ACTIONS

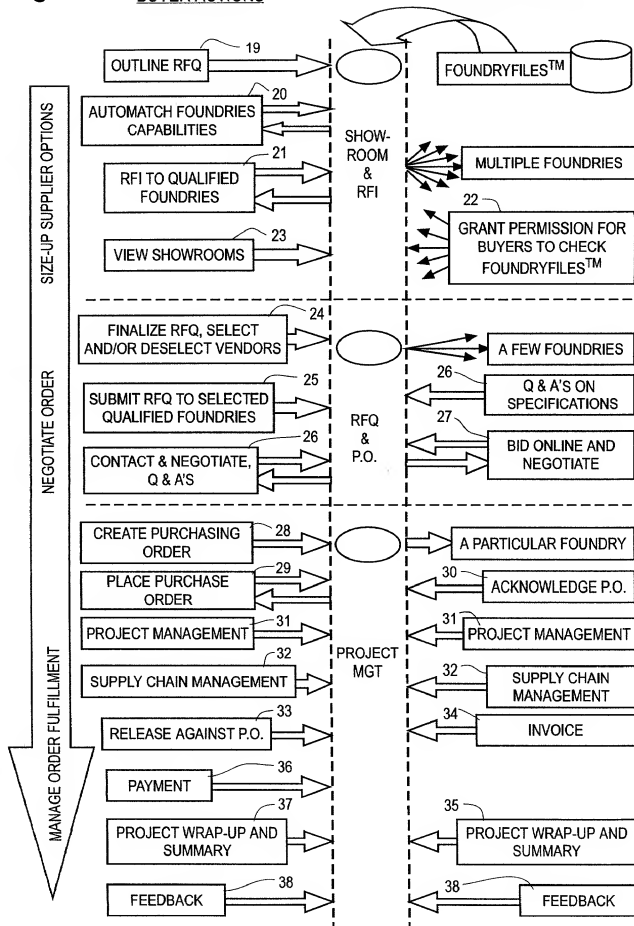
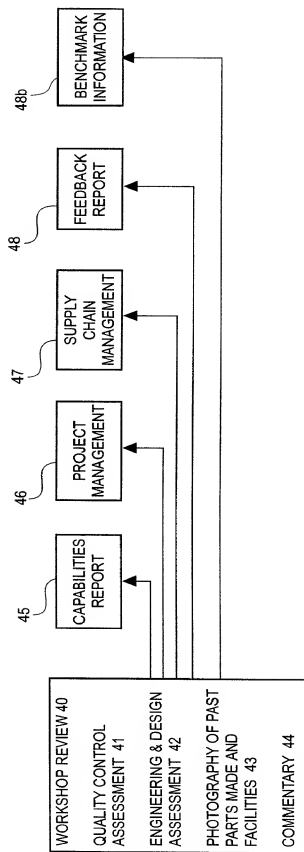


Fig. 4



Introduction

This is a procedure for the audit of a foundry as the basis for a FoundryFiles™ report for evaluation and assessment of foundry technical capabilities, production capacities, quality control, engineering and design, and management, service and training.

Part I: Technical Capabilities**1) Production Capacity**

Workshop size: _____

Casting weight range (ton): _____

Casting size range (mm): _____

Average weekly tonnage: _____

Maximum weekly tonnage: _____

Production capacity used: _____

2) Technical Capabilities

Types of melting facilities:

- Electric induction/ electric arc cupola/other _____

Design facilities: ☐ Yes ☐ No Number of employees _____

Patternmaking facilities: ☐ Yes ☐ No Number of employees _____

Machining facilities: ☐ Yes ☐ No Number of employees _____

Type of machines:

- ☐ Conventional/ ☐ NC/ ☐ CNC/ ☐ lathes/ ☐ borers vertical or horizontal/
☐ drills, bench, radial, multi-pindle/ ☐ other, please specify _____

Is pattern/ machining shop directly controlled by foundry? ☐ Yes ☐ No

Is above capacity tied to own use/ associate/ group companies? ☐ Yes ☐ No

If so, what is the percentage/ tonnage? _____

Coremaking facilities

- ☐ Oil sand ☐ CO2 ☐ shell ☐ No-bake, chemical bonded ☐ other

Industrial standards used:

- ☐ ANSI Y14.5M-1982
- ☐ ISO 8062
- ☐ ASTM
- ☐ ASME
- ☐ AA
- ☐ EU
- ☐ Other, please specify _____

3) Casting Processes

- ☐ Conventional molding process
 - ☐ Green sand casting
 - ☐ High density molding
 - ☐ Flaskless molding
 - ☐ Tight Flask molding
 - ☐ Skin-Dried and dry sand molding
 - ☐ Other, please specify _____
- ☐ Precision molding and casting processes
 - ☐ Permanent molding ("Gravity die casting")
 - ☐ Low pressure molding ("Die casting")
 - ☐ High pressure molding ("Die casting")
 - ☐ Investment casting ("Lost Wax")
 - ☐ Ceramic molding ("Shaw process")
 - ☐ Hitchiner process ("CLA, CLAS, CLAV")
 - ☐ Other, please specify _____
- ☐ Chemically bonded sand molding processes
 - ☐ Shell molding (Organic)
 - ☐ Sodium Silicate CO2 Bonded molding (Inorganic)
 - ☐ No-Bake molding (Chemically bonded self-setting sand mixtures)(Organic)
 - ☐ Other, please specify _____
- ☐ Special and innovative molding and casting processes
 - ☐ Evaporative Pattern Casting (EPC)
 - ☐ Vacuum ("V") Process Molding
 - ☐ Centrifugal Process Molding
 - ☐ "H" Process Molding
 - ☐ Lost Foam Molding
 - ☐ Other, please specify _____

4) Casting Materials Used

- ☐ Ferrous Metals
- ☐ Gray Iron

- ☐ Class 20 ☐ Class 30 ☐ Class 40 ☐ Class 50 ☐ Class 60
☐ White Iron Ni-Hard, High Cr.
☐ Alloyed Irons, Ni-Resist
☐ Compacted Graphite Irons
☐ Other, please specify _____

☐ Ductile Iron

- ☐ Ferritic (60-40-15, 60-45-12, 60-40-18)
☐ Pearlitic/Ferritic (80-55-06, 80-60-03)
☐ Pearlitic (100-70-03)
☐ Martensitic (120-90-02)
☐ Bainitic (130-100-04)
☐ Other, please specify _____

☐ Malleable Iron

☐ Steel

- ☐ Carbon and low alloy
☐ Corrosion resistant steel
☐ Heat-resistant steel
☐ Manganese-Wear resistant steel

☐ Ferrous Metals

- ☐ Brass
☐ Bronze
☐ Nickel-Base Alloys
☐ Zinc Base Alloys
☐ Aluminum Alloys
☐ Sand casting and permanent mold alloys
☐ Die-casting alloys
☐ Aluminum-Magnesium Alloys
☐ Magnesium Alloys

Part II: Workshop Review

Part I requires the auditor to visit the main manufacturing departments of the foundry and make notations covering three main aspects of each: machine types, proof of calibration, and operator procedures (SPS).

- Machine types: determine at least Machine "model" and "maker" from machine label plates. "Capacity" and "year made" information may be supplied by foundry personnel.

Molding machines:

9/17

Fig. 5d

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

2) Flask sizes

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

3) Sand Mixer

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

4) Molding boxes

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

5) Mould handling system

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

6) Sand plant

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

7) Melting furnace:

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

8) Machining equipment

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

9) Tooling machines -- Manual

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

10) Tooling machines -- CNC

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

11) Tooling machines -- RP

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

12) Tooling machines -- Other

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

13) Post-Finishing Facilities (Report on five machines of foundry's choice)

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Machine model: _____ Maker _____
 Capacity: _____ Year made: _____
 Calibrated by: _____ Date: _____
 Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Part III: Special Capabilities Review

Part II has three distinct parts: assessment of the quality lab (instrumentation) and of the design center (CAD/CAM), and photography of representative output in the form of in-process castings.

(A) Quality Laboratory Assessment

Part A requires the auditor to go to the quality laboratory of the foundry and go through the steps indicated in Part I above for the main workshop areas: identify machine types, obtain proof of calibration, and assess operator competence.

(1) Awards received

Name of awards _____
 Awarded by _____ Date _____
 Name of awards _____
 Awarded by _____ Date _____
 Name of awards _____
 Awarded by _____ Date _____
 Name of awards _____
 Awarded by _____ Date _____
 Name of awards _____
 Awarded by _____ Date _____

12/17

Fig. 5g

Name of awards _____
Awarded by _____ Date _____

(2) ISO 9000 certified?

ISO Series Certified: _____
Audited by: _____ Date: _____

(3) QS 9000 certified?

If certified,
Audited by: _____ Date: _____

(4) ISO 14000 certified?

If certified,
Audited by: _____ Date: _____

(5) 6 σ implementation?

Date from _____
Audited by: _____ Date: _____
Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

(6) CMM

Type: _____
Calibrated by: _____ Date: _____
Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

7) Digital laser measurement system

Type: _____
Calibrated by: _____ Date: _____
Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

(8) Non-destructive testing (X-Ray, etc)

Type: _____
Calibrated by: _____ Date: _____
Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

(9) Mechanical properties testing machines

Type: _____
Calibrated by: _____ Date: _____
Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

(10) Thermal testing machines

Type: _____
Calibrated by: _____ Date: _____
Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

(11) Hardness testing machines

13/17

Fig. 5h

Type: _____

Calibrated by: _____ Date: _____

Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

(12) Pouring monitoring (electromagnetic treatment)

Methods: _____

Equipment used: _____

Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

(13) Dimensional accuracy

Process: _____ Accuracy _____ Standards used _____

Calibrated by: _____ Date: _____

Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Process: _____ Accuracy _____ Standards used _____

Calibrated by: _____ Date: _____

Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Process: _____ Accuracy _____ Standards used _____

Calibrated by: _____ Date: _____

Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Process: _____ Accuracy _____ Standards used _____

Calibrated by: _____ Date: _____

Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

Process: _____ Accuracy _____ Standards used _____

Calibrated by: _____ Date: _____

Operation: ☐ very complete knowledge ☐ acceptable ☐ incomplete understanding

(B) Engineering and Design Center Assessment

Part B is a simple inventory of CAD/CAM/CAE software. It requires the auditor to go to the foundry's engineering and design center, sit at a computer module, and have the operators display the software installed for identification.

Pro/Engineer ☐ Version: _____

No. of licenses _____

CATIA ☐ Version: _____

No. of licenses _____

I-Deas ☐ Version: _____

No. of licenses _____

UG-II ☐ Version: _____

No. of licenses _____

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Solidworks ☐ Version: _____
 No. of licenses _____

Magma: ☐ Version: _____
 No. of licenses _____

ABAQUS ☐ Version: _____
 No. of licenses _____

Other ☐ Version: _____
 No. of licenses _____

Other ☐ Version: _____
 No. of licenses _____

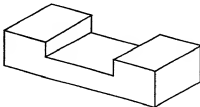
Other ☐ Version: _____
 No. of licenses _____

(C) Photography of in-process castings

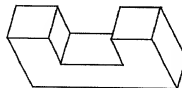
Part C requires the auditor to take a series of photographs of representative output of the foundry. The fundamental requirement is that all pieces photographed should be taken from work in process – NOT from finished goods inventory or showroom. [Note: The foundry will have a separate option to display goods of their choice from their showroom in connection with the castingtrade.com site.]

The ideal is to photograph ten different pieces. Some of the photographs should be taken after the final finishing stage. It would be good to take some at the just-cast stage, as well (and ideally covering several different stages of the same piece).

The format of the photograph should be at an isometric or trimetric view.



Isometric View



Trimetric View

(D) Management, Service and Training Program

What kind of management systems used now?

☐ JIT ☐ ERP ☐ CIMS ☐ FMS ☐ TQM ☐ Other, please specify _____

Advice for casting pattern, process, materials and design? ☐ Yes ☐ No

Own delivery facilities? ☐ Yes ☐ No

If, yes, what's the transportation capacity? _____

Education/Training programs for continuous improvements? ☐ Yes ☐ No

If yes, list the program title(s):

Part IV: Commentary

Space is provided for other comments and observations by the auditor. This time may also be used to make sure all other parts of the report form are complete, fill in any missing information, and add any additional comments.

Fig. 6

Cast Metal Parts Project Management -- Key Steps

(To be included in project management software.)

Tooling

- Drawing interpretation
- 3D modeling
- Master pattern fabrication
- Coremaking
- Mold making

Inspection

- Visual inspection
- Dimensional inspection
- Non-destructive testing

Parts Casting

- Mold layout
- Metal melting
- Testing pouring
- Process control
- First article part
- Volume production

Shipping

- Shipment schedule
- Shipment implementation
- Clear customs (if applicable)
- Shipment tracking
- Shipment received

Finishing

- Sprue removal
- Snapping, chipping & cleaning
- Tumbling, pickling & welding
- Heat treatment

Fig. 7

